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TECHNICAL NOTES

of the



ALASKA FOREST RESEARCH CENTER

U. S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE

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No. 45

IDENTIFICATION OF SPRUCE SEEDLINGS IN INTERIOR ALASKA

Mature white spruce (Picea glauca (Moench) Voss) and black spruce (Picea mariana (Mill.) B.S.P.) in the Alaska interior are readily distinguished by the pubescence of black spruce branchlets and differences in cone structure, shape, and color. In the juvenile stage, however, these species are difficult to separate. This problem is not confined to Alaska. Characteristics used to identify spruce seedlings have been reported from several other regions.

Other Regions

In Minnesota, LeBarron^{1/} found that 82 percent of the white spruce seedlings have 6 cotyledons while the remainder have 4 or 5. He reported that seedlings of black spruce have mostly 4 cotyledons (76 percent) while 21 percent have 5 or 6, and 3 percent have 2 or 3.

Place^{2/} found that in the Maritime Provinces of Canada:

1. Pubescence of the stem is an unreliable characteristic in the seedling stage.
2. The appearance of the terminal bud is often a good index. The bud scales of white spruce tend to be short and overlapping while the basal bud scales of black spruce are long enough to cover the entire bud and project beyond its tip. The coloring of the buds seems to vary with the degree of exposure to the sun and thus is of little help as a guide. White spruce buds are usually light or yellowish-brown and those of black spruce reddish-brown. Unfortunately, mature buds are lacking during most of the growing season and, even when present, are atypical on a 1- or 2-year-old seedling.
3. Preliminary counts indicate that 6 percent of the white spruce seedlings have 5 cotyledons, 77 percent have 6, and 17 percent have 7 cotyledons.

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^{1/} LeBarron, Russel K. Silvicultural management of black spruce in Minnesota. U.S. Dept. Agr. Circ. 791. 60pp. 1948.

^{2/} Place, I. C. M. The identification of spruce seedlings. Canada, Dept. Res. and Develop., For. Branch, For. Res. Div. Silv. Leaflet No. 40. 2 pp. 1950.

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4. The margins of the juvenile needles of black spruce are smooth while those of white spruce are serrulate with fine teeth on each of the four edges of the needle. This characteristic is occasionally absent from the needles of unthrifty white spruce seedlings; but when present, the teeth may be seen with a 4- or 10-power hand lens. The cotyledons appear to be free of teeth.

Place^{3/} later collected seed of white and black spruce from the south-central province of New Brunswick. Germinating this seed in sandflats, he found that at the end of the first growing season white and black spruce averaged 6.1 and 4.6 cotyledons, respectively. These averages were based upon 316 white and 262 black spruce.

In France, de Ferré^{4/} studied seedlings of 103 species of conifers. He reported white spruce, called *P. canadensis*, as having 4 to 7 cotyledons and the youngest leaves denticulate. According to de Ferré, white spruce seedlings 1 year old, 2-3 years old, and 4-5 years old, have leaves denticulate in the upper half while plants 7-10 years old, 15-25 years old, and mature plants have leaves with entire margins. He states that black spruce, called *P. negra*, have 5-6-8 cotyledons, and leaves with entire margins on plants of all ages.

Brayshaw^{5/} reports white spruce as having 5 to 7 cotyledons with primary leaves serrate, and black spruce as having 3-5 cotyledons with primary leaves entire.

Alaska

Spruce seedlings were examined under laboratory and field conditions in Interior Alaska. Laboratory seedlings were grown from seed. Those examined in the field were taken from areas where only one or the other of the two species were growing so that the species of seedlings was known. A total of 476 white spruce and 131 black spruce, 1 year old or less, were examined.

Without exception the cotyledons and primary leaves of 1-year seedling white spruce had serrulate edges (fig. 1) while all leaves of black spruce had entire margins. Serrulations could easily be seen with a 7-power hand lens and were often visible with the unaided eye.

^{3/} Place, I. C. M. Comparative growth of spruce and fir seedlings in sandflats. Canada, Dept. of Res. and Devel., For. Branch, Div. For. Res. Silvi. Leaflet No. 64. 4 pp. 1952.

^{4/} Ferré, Y. de. Les Formes de Jeunesse des Abiétacées ontogénie-phylogénie. Laboratoire Forestier de Toulouse Travaux Tome 2, Vol. 3., art. 1. 277 pp. 1952.

^{5/} Brayshaw, T. C. Tree seedlings of eastern Canada. Canada, Dept. North. Affairs and Nat. Res., For. Branch Bul. 122. 38 pp. 1959.

The percentage of sample seedlings from Alaska having varying numbers of cotyledons is compared with reports from the above references in table 1. The Alaska sample indicates that, as elsewhere, white spruce average more cotyledons per seedling than black spruce. Also, white spruce never had less than 4 cotyledons while black spruce never had more than 6. It is likely that exceptions may occasionally occur.



Figure 1.--Serrulate margins on 1-month-old juvenile leaves of white spruce.

Table 1.--Reported numbers of cotyledons on white and black spruce seedlings

Report	Species	Number of cotyledons					Average number of cotyledons
Source		3	4	5	6	7	
<u>Percent of seedlings</u>							
Alaska	White spruce	0	8	39	50	3	5.5
	Black spruce	5	43	47	5	0	4.5
LeBarron ^{1/}	White spruce	--	--	--	82	--	--
	Black spruce	--	76	--	--	--	--
Place ^{2/}	White spruce	0	0	6	77	17	--
	Black spruce	- - -	Not reported			- - -	--
Place ^{3/}	White spruce	--	--	--	--	--	6.1
	Black spruce	--	--	--	--	--	4.6

Seedlings from 2 through 8 years old were also examined in the field. Serrulations were found on leaves of all older white spruce seedlings; black spruce leaves had entire margins. New leaves occurring on white spruce after the fourth year often had no serrulations but

^{1/} See footnote ^{1/}, page 1.

^{2/} See footnote ^{2/}, page 1.

^{3/} See footnote ^{3/}, page 2.

the seedlings could be identified by examining older leaves (table 2). Serrulations tend to be very sparse and small in leaves produced after the fourth year. On 5-year or older seedlings serrulations may be limited on current-, second-, or even third-year leaves on the lower lateral branches. Leaves of white spruce apparently are without serrulate edges after the seedlings reach 9 or 10 years of age.

Table 2. --Occurrence of serrulate margins on leaves of white spruce, by leaf age and total age of seedling

Total age of seedling, yrs.	No. of seedlings examined	Age of leaves					
		Current yr.	Second yr.	Third yr.	Fourth yr.	Fifth yr.	Sixth yr.
<u>Percent with serrulate margins</u>							
2	5	100	100	---	---	---	---
3	13	100	100	100	---	---	---
4	3	100	100	100	100	---	---
5	29	72	83	100	100	---	---
6	6	17	50	100	100	100	---
7	4	25	50	100	100	100	100
8	15	27	33	73	100	100	100

Discussion

In Interior Alaska, and probably in most other areas where there is the problem of identifying white and black spruce, the presence or absence of serrulate-edged cotyledons and leaves is probably a reliable characteristic on trees up to about 9 or 10 years of age. The number of cotyledons may be of some help in the early juvenile stage. A means of identification between about 10 years of age and the unknown age when distinguishing features noted in mature trees develop, is still needed.

An additional problem in spruce taxonomy is in the North Gulf Coast areas of Alaska where Sitka spruce (*Picea sitchensis* (Bong.) Carr) intermingles with white and black spruce and crosses with white spruce resulting in the hybrid Lutz spruce (*Picea X lutzii* Little^{6/}). Sitka spruce is reported to have juvenile leaves with entire margins.^{7/} Identification of mature spruce is difficult in this area. Seedling identification is probably exceedingly difficult.

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6/ Little, Elbert L., Jr. A natural hybrid spruce in Alaska. Jour. Forestry 51(10):745-747. 1953.

7/ See footnote 4/, page 2.